AECOM Design + Planning

Preferred Project Report

Rainbow Beach Concept Plan
MO 06_0085

Part 3A Concept Plan | St. Vincent's Foundation Pty. Ltd. | 9 May 2011

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Preferred Project Report

Rainbow Beach Concept Plan

Prepared for

St Vincent's Foundation Pty Ltd

Prepared by

AECOM Australia Pty Ltd
Level 8, 17 York Street, Sydney NSW 2000, Australia
T +61 2 8023 9333 F +61 7 8023 9399 www.aecom.com
ABN 20 093 846 925

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Prepared by	Natasha Ridler
Reviewed by	Vince Berkhout

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1.0 Introduction

1.1 The Proposal

The St. Vincent's Foundation Pty Limited (the proponent) is seeking approval for a Concept Plan (MP 06_0085) and Project Application (MP 07_0001) on a 177.4 ha parcel of land located within the Port Macquarie – Hastings local government area (LGA) between the coastal villages of Bonny Hills and Lake Cathie. The Project Application is the initial development stage of the overall Concept Plan and comprises drainage, open space and habitat restoration works. This Preferred Project Report relates to the Concept Plan component of the proposal, as described below.

1.1.1 Concept Plan

The Concept Plan application seeks approval for the delineation of future land uses within the 177.4 ha site as follows:

- the delineation of the limits of the residential subdivision;
- the location of the three adopted intersections with Ocean Drive;
- the location of an additional intersection with Ocean Drive currently under investigation by Port Macquarie – Hastings Council (Council);
- the delineation of the extent of the future school sites;
- the general location of the Greater Lake Cathie Bonny Hills Village Centre
- the delineation of the development area of Lot 5 DP 25886 (previously referred to as the eco-tourist site);
- the delineation of the extent of the open space, drainage and wildlife habitat corridors.

Details of the Concept Plan application and environmental assessment are outlined in the *Concept Plan 06_0085 Rainbow Beach Environmental Assessment Report*, dated August 2010, prepared by Luke & Company Pty Ltd.

1.1.2 Preferred project

The exhibited proposal has been amended and addition information has been provided in response to submissions received during the exhibition period and following review by the proponent.

The only change proposed to the Concept Plan relates to future development of Lot 5 DP 25886, the site previously referred to the eco-tourist site. The preferred project removes the eco-tourist land use and recommends Lot 5 DP 25886 be developed as low density residential with a designated development footprint.

This report incorporates additional details to illustrate how the urban components of the Concept Plan will be developed in the future. This additional information, which is detailed in Section 2.0 of this report includes:

- A principles plan for Lot 5 DP 25886 which illustrates interface and setback areas, and delineates the extent of land for development, following a more detailed consideration of site constraints.
- A series of urban design principles plans that clarify the framework and strategic intent for site development, particularly with regard to future urban form.
- A staging plan that illustrates indicative staging of proposed residential precincts.

1.2 Purpose of the document

During the exhibition of the Concept Plan and Project Application environmental assessments, 25 submissions were received. The Director-General of the DoP provided copies of the submissions to the proponent. In accordance with section 75H(6) of the EP&A Act, the Director-General required the proponent to address the issues raised in the submissions. If the response required changes to the Concept Plan or Project Application to minimise environmental impact, a preferred project report was to be prepared and the statement of commitments to be revised for both the Concept Plan and Project Application.

The exhibited proposal has been amended in a number of respects in response to submissions received during the exhibition period and following review by the proponent. This report outlines the proposed amendments to the Concept Plan specifically. These changes are detailed in Section 2.0.

The statement of commitments has been revised to clarify and strengthen planning and environmental management actions, as outlined in Section 3.0.

This report is accompanied by two additional reports prepared by AECOM, being the Concept Plan and Project Application Submissions Report and the Project Application Preferred Project Report. The Submissions Report identifies the issues raised during exhibition of the Concept Plan and Project Application Environmental Assessments (EAs) and provides the proponent's responses. The Project Application Preferred Project Report includes a description of changes to the Project Application and a revised statement of commitments.

The three volumes outlined above should be read concurrently. These reports should also be read in conjunction with the Concept Plan EA prepared by Luke & Company Pty Ltd (referenced above) and the Project Application details and environmental assessment contained within the *Environmental Assessment Report: Rainbow Beach Project Application Central Corridor and Associated Works*, dated 8 July 2010, prepared by AECOM.

1.3 Specialist assessment

An addendum specialist assessment has been provided by Darkheart Eco-Consultancy (Darkheart) in response to the Lot 5 DP 25886 principles plan titled *Rainbow Beach Concept Plan (06_0085) PPR – Lot 5 Delineated Development Area*, April 2011. The addendum ecology assessment is included at Appendix A of this report.

AECOM has prepared a report titled *Lot 5 Stormwater Treatment Requirements*, April 2011, which outlines the stormwater treatment requirements for development of the designated development area for Lot 5. The stormwater assessment is included at Appendix B of this report.

2.0 Additional concept information

2.1 Lot 5 DP 25886 principles plan

As outlined within the Concept Plan EA, an undefined area on Lot 5 was previously nominated for an eco-tourist development. In response to submissions and following review by the proponent, the preferred concept is for the development of low density residential development over a specifically designated development area located in the central northern portion of Lot 5. This change has resulted in modifications to the breakdown of development areas for the Concept Plan. Table 1.1 outlines the amended areas as proposed within the preferred project (changes in bold italics). Amended areas are illustrated in Figure 1.

Table 1.1 Original and proposed development areas

Development area component	Original area (ha)	Proposed area (ha)
Residential area	67.8	***70.2***
Open space, drainage and wildlife habitat corridors	80.9	***86.1***
Village centre	4.8	4.8
Northern school site	5.0	5.0
Southern school site	9.7	9.7
Ocean Drive buffer	1.6	1.6
Eco-tourist site	7.6	***0***
Total	**177.4**	**177.4**

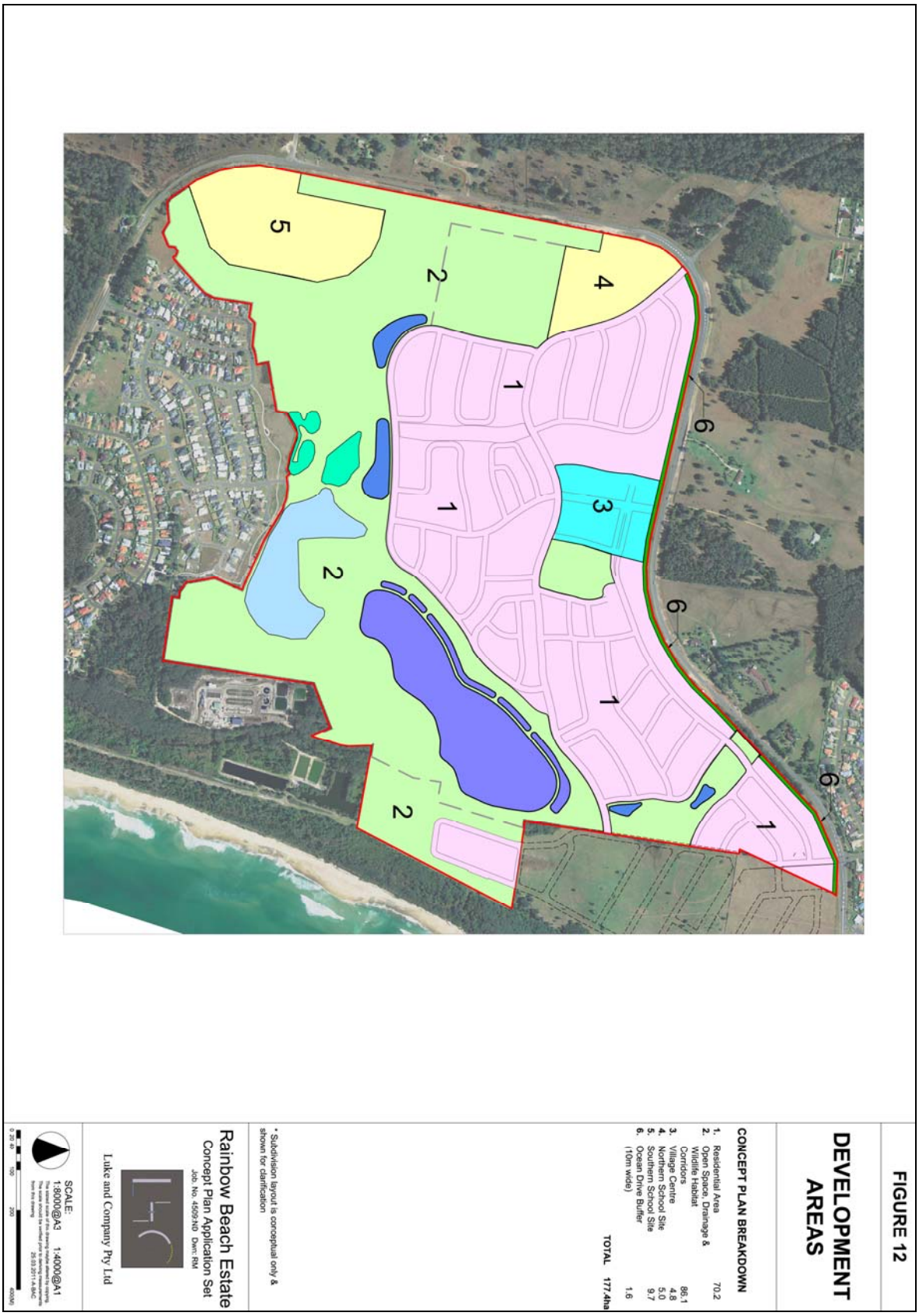
Source: Luke & Co, 2011

A principles plan for Lot 5 DP 25886 has been developed to illustrate interface areas and delineates land available for development following a more thorough consideration of site opportunities and constraints. As detailed in Figure 2, the principles plan is made up of four primary interface zones as follows:

- Zone 1: sewage treatment plant buffer / existing coastal forest
- Zone 2: sewage treatment plant buffer / regenerated coastal forest
- Zone 3: SEPP 26 / coastal vegetation interface
- Zone 4: riparian forest interface

Figure 2 also identifies the designated developable area (DDA), being land identified for future development following the exclusion of Zones 1 – 4. Details of the DDA and each zone are outlined in Table 2.1.

Figure 1 Concept Plan development areas



Source: Luke & Co, 2011

Figure 2 Lot 5 principles plan

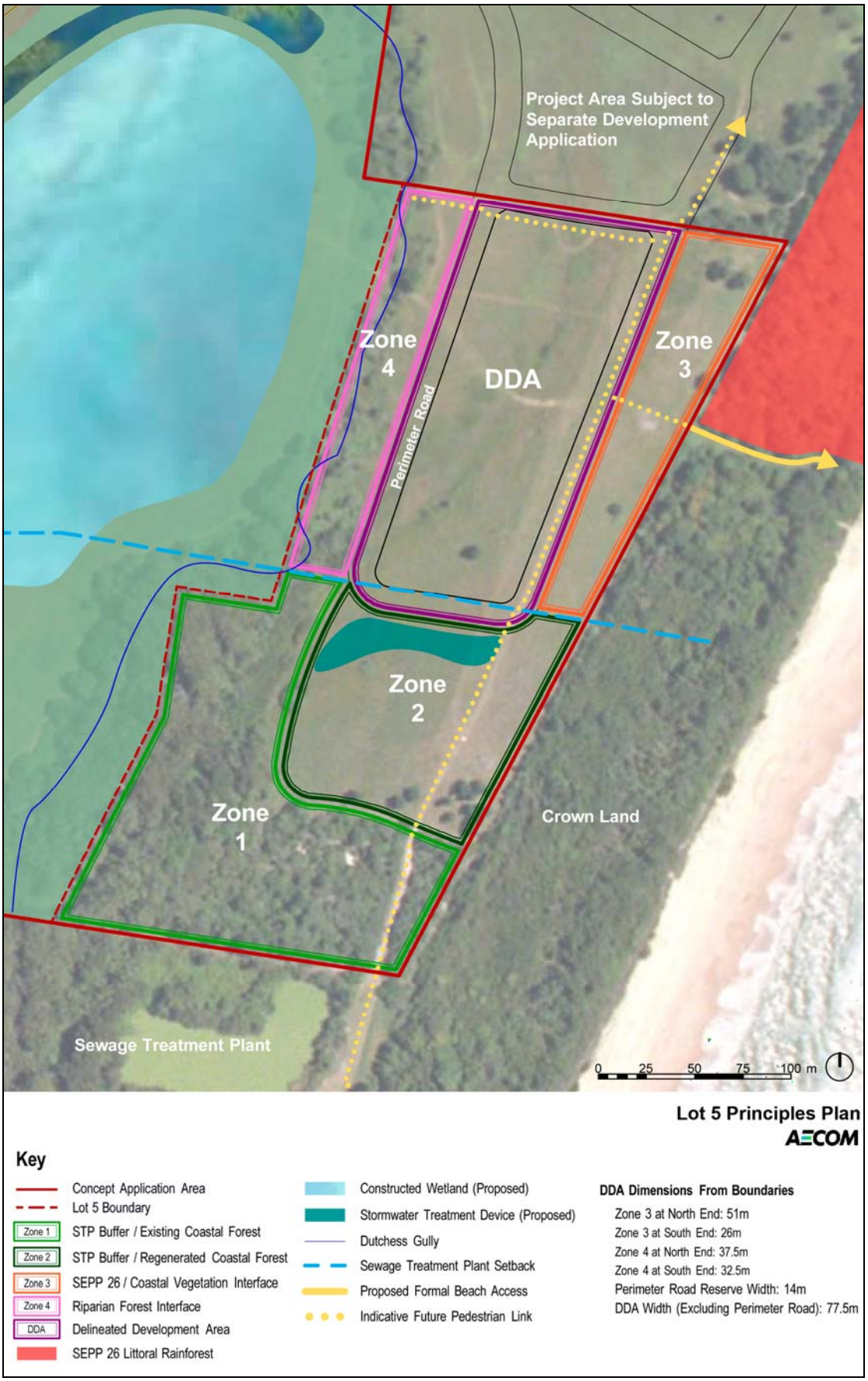


Table 2.1 Lot 5 interface zones and DDA

Zone	Proposed elements and characteristics	Ownership and management
Zone 1	Sewage treatment plant buffer: • Approximately 2.25 ha in area. • Currently zoned Rural RU1 as per Port Macquarie – Hastings Local Environmental Plan 2011 (PMHLEP 2011). • Includes STP setback as per PMHLEP 2011. • Existing and regenerated forest vegetation will provide screening to the STP and serve as a habitat link between existing coastal vegetation on Crown land and the Central Corridor.	Council – following subsequent project or development application for Lot 5 and associated VPA negotiation.
Zone 2	Sewage treatment plant buffer: • Approximately 1.35 ha in area. • Currently zoned Rural RU1 as per PMHLEP 2011. • Includes STP setback as per PMHLEP 2011. • Potential to include 1760 m^2 constructed wetland to treat stormwater runoff from the DDA. • Existing pasture will be regenerated to structured costal forest. • Proposed vegetative transition planting will provide an interface between future development and existing coastal vegetation on Crown land. • Incorporates connectivity to coastal walkway and cycleway network.	Council – following subsequent project or development application and associated VPA negotiation.
Zone 3	SEPP 26 / coastal vegetation interface: • Approximately 0.8 ha in area. • Currently zoned General Residential R1 as per PMHLEP 2011. • Proposed vegetative transition planting will provide an interface between future development and existing SEPP 26 littoral rainforest and coastal vegetation on Crown land. • Incorporates connectivity to Rainbow Beach (formal access). • Potential for inclusion of public car parking. Note: Parking will not intrude into the vegetative screen planting. • Prohibition of stormwater flows from DDA discharging onto or across Zone 3.	Council – following subsequent project or development application and associated VPA negotiation.
Zone 4	Riparian forest interface: • Approximately 0.8 ha in area. • Currently zoned General Residential R1 as per PMHLEP 2011. • Retention and enhancement of existing riparian forest along Duchess Gully. • Includes stormwater treatment devices to treat stormwater runoff from the DDA.	Council – following subsequent project or development application and associated VPA negotiation.
DDA	Delineated Development Area (DDA): • Approximately 2.39 ha in area. • Currently zoned General Residential R1 as per PMHLEP 2011. • Previously zoned Residential 2(a)1 under Hastings LEP 2001. • Identified for residential use under the Area 14 Structure Plan. • Defined as the land available for development following exclusion of Zones 1, 2, 3 and 4. • Roads, public car parking area and asset protection zones associated with residential development of Lot 5 all to be located within boundary of DDA. • Incorporates connectivity to coastal walkway and cycleway network within DDA.	Private ownership, subject to future roads (associated with residential development of Lot 5) and public car parking area (associated with formalised beach access) to be dedicated to Council.

2.1.1 Ecological assessment

An ecological assessment of the preferred concept for development of Lot 5 has been undertaken by Darkheart (2011) (see Appendix A).

Vegetative interface planting

Vegetative planting proposed within Zones 2 and 3 has been recommended by Darkheart Eco-consultancy (Appendix 6b of Concept Plan EA) to provide an interface between future development on Lot 5 and the adjacent SEPP 26 littoral rainforest and coastal vegetation on Crown land. Plate 1 illustrates the existing coastal vegetation as it meets currently cleared areas of Lot 5. Proposed interface planting will consist of predominantly rainforest species in a fully structured vegetation community. A gradation from east to west will occur in structure and floristics, with protective species occupying the interface of the edge of the DDA and the western edge of Zones 2 and 3.

Within Zone 3, the proposed vegetative planting will vary in width from 51 m as per the coastal vegetation setback of the neighbouring property to the north, reducing to 26 m at the southern end of the zone. This transition in width is in line with the coastal interface area outlined within Council's Area 14 Structure Plan (see Figure 4). Darkheart (2011) has advised that the widening of Zone 3 to match the adjoining buffer to the north is in line with the principles of SEPP 26 and rainforest restoration and that planting of vegetation along the eastern boundary of Zone 2 could have long term restoration benefits for existing rainforest vegetation in formerly sand mined Crown land adjacent to Zone 2.

Implementation and management of planting will be outlined within a vegetation management plan for Lot 5 (including zones 1 to 4 and the DDA where required) informed by ecological investigations in association with future project or development application(s) for the site.

Plate 1 View from within Lot 5 to existing coastal vegetation

Source: Darkheart, 2009

Enhanced wildlife movement corridor

Following establishment of planting within Zones 1 and 2, the east-west movement corridor connecting the coastal forest and Central Corridor will reach a width of 175 m across Lot 5. Darkheart (2011) has advised that this width meets the recommended corridor width for effective wildlife movement and satisfies DECCW's priorities of enhancing connectivity between coastal lowlands and hinterland to address evolutionary trends and pressures induced and intensified by climate change. Plate 2 illustrates the existing pasture land within Lot 5 to be revegetated (Zone 2) and existing forest vegetation within STP buffer (Zone 1).

Plate 2 View from within Lot 5 to southern edge of STP buffer

Source: Darkheart, 2009

Eastern Chestnut Mouse

The Eastern Chestnut Mouse was identified as a potential ecological constraint for Lot 5 in Darkheart's site wide ecological assessment (Appendix G of the Project Application EA). However based on observations over periodic site visits since 2003 (Darkheart 2011), persistence of the previously recorded small population is now considered unlikely given the pasture is grazed by cattle and periodically slashed. Recent habitat loss and modification of swamp forest on adjacent land to the south associated with expansion of the Bonny Hills STP has further reduced the extent of potential habitat available to support a viable population of this species.

2.1.2 Stormwater management assessment

Concept design for the management of stormwater for future residential development within the DDA has been prepared by AECOM (2011) (see Appendix B). Stormwater from this site could be treated by either:

- a single constructed stormwater treatment wetland; or
- bioretention systems distributed around the development.

Both stormwater treatment options are able to meet adopted criteria in accordance with Council's IWCM policy and are consistent with the approaches and recommendations regarding water management for the proposal (see Appendix L, M and N of the Project Application EA). A brief summary of each option is provided below. Final design of stormwater treatment elements will be undertaken as part of a future development application for the site.

Stormwater treatment with constructed wetland option

Stormwater runoff generated on Lot 5 will be discharged to Duchess Gully. Lot 5 sits on dune sands and will be constructed as flat terrain. Therefore, to accommodate the likely small level difference between the surface level and the discharge to Duchess Gully a 1760 m^2 constructed wetland is proposed for stormwater treatment. End-of-pipe constructed wetlands for stormwater treatment can work successfully in flat areas as very little grade difference is required to convey water through the wetland, whereas end-of-pipe bioretention systems require sloping sites in order to discharge treated water below surface level.

An appropriate location for the constructed stormwater treatment wetland is identified in Zone 2 (see Figure 2). Zone 2 is large enough to contain the required stormwater treatment wetland and drainage can be easily connected to an existing drainage line to Duchess Gully. Additionally, a wetland in this location provides a distinctive landscape asset for the residents while providing road access for easy maintenance. Zone 2 is designated for bush regeneration works in the future, and the constructed wetland in this location is compatible with the use of this land for habitat provision. It was not considered practical to locate the constructed wetland in Zone 4 due to its narrow width and likely inadequate distance from Duchess Gully.

Stormwater treatment with distributed bioretention systems

Bioretention systems distributed around the catchment can provide an alternative to constructed wetland systems. For this option to be viable, runoff must be directed to the bioretention system prior to reaching the stormwater drainage network. Filtered stormwater can then be directed from the bioretention system directly into the stormwater pipe network. Any overflow from the bioretention systems can bypass into nearby and typical side entry pits. Bioretention systems could be located in the following areas and characteristics:

- Distributed around the development as landscape elements within the streetscape to provide traffic calming, visual buffering and shade.
- Alongside the Duchess Gully riparian corridor in Zone 4 (refer Figure 2).
- Some bioretention systems could provide a transition between the urban area and the bush regeneration to take place in Zone 2.

2.1.3 Designated development area assessment

Land use and urban form

The preferred project removes the eco-tourist land use previously proposed for Lot 5 and recommends the DDA be developed as low density residential.

As detailed in Section 3 of the Concept Plan EA, the site has been zoned for residential development since 1984. Figure 3 identifies the site as being zoned 2(a1) Residential under Hastings Local Environmental Plan 2001 (HLEP 2001). This residential zoning was reiterated in 2004 in Council's Area 14 Structure Plan which identified the DDA as being suitable for residential/tourist uses (Figure 4). The residential zoning was most recently carried through in Council's LEP standard instrument amendment, which zoned the site as R1 General Residential under PMHLEP 2011 (Figure 5).

Consistent with Council's Area 14 Structure Plan, the DDA forms an extension of the adjacent Milland & Seawide development immediately to the north, with vehicular access to Lot 5 being provided via this adjoining development.

Permissible development within the R1 General residential zone includes amongst others, dwelling houses; multi dwelling housing; residential flat buildings; and tourist and visitor accommodation. Notwithstanding this variety of permissible uses, the proponent intends to develop the DDA as low density residential only, as this land use is considered to be the lowest impact, while still providing for consistency with Council's area 14 Structure Plan and LEP zone objectives.

Future development within the DDA will be guided by the urban design guidelines outlined in Section 2.2.4 and Council's development control plan (DCP) for residential or tourist development within Area 14. Detailed site analysis and design will be undertaken as part of a future development application for the site.

Density

The DDA within Lot 5 will be developed with a density of no more than 15 dwellings/ha. Following exclusion of Zones 1, 2, 3 and 4 from the total area of Lot 5, a total area of 2.39 ha has been identified for development (including the perimeter road).

Based on the developable area of 2.39 ha and maximum density of 15 dwellings/ha, an overall yield of 34 dwellings may be achievable for Lot 5. Final dwelling yield and subdivision layout will be determined following detailed site analysis undertaken as part of a future development application for the site.

The size of the DDA allows for almost 70% of the Lot 5 site area to be retained for revegetation and restoration. Further, the DDA is significantly smaller than the area nominated in Council's Area 14 Structure Plan as being earmarked for residential/tourist uses (see Figure 4).

Asset protection zones

The Lot 5 principles plan shows the residential area defined by a 14 m wide perimeter road to the eastern, southern and western edges, with the perimeter road to the north being a shared road with the adjoining property. APZs are proposed to be located predominantly within this 14 m wide perimeter road to the east, south and west, and will extend into the front setbacks of individual allotments where required. Due to the adjoining proposed urban development to the north, APZs will not be required along this boundary. APZs will not be located within any part of Zones 3 or 4 and will be included within Zone 2 only over the area identified as perimeter road. Final APZs will be determined as part of future development applications for the site. Implementation and management of APZs will be outlined within a vegetation management plan for the whole of Lot 5 (including Zones 1 to 4 and the DDA where appropriate).

2.1.4 Lot 5 approach summary

The Lot 5 principles plan illustrates interface areas and delineates land available for low density residential development following a more thorough consideration of site opportunities and constraints. The principles plan reduces potential development impacts and enables a number of environmental benefits as follows:

- Retention and enhancement of existing vegetated areas within the site.
- Revegetation of the majority of the site to increase habitat and movement corridors while providing interface areas between coastal vegetation and future development.
- Creation of a minimal development area for low density residential development that will not undermine the environmental integrity of the site.
- Provision of integrated stormwater management options that are consistent with Council's IWCM policy.
- Provision of a perimeter road and adequate development area width to accommodate APZs.
- Consistency with Council's Area 14 Structure Plan and zoning map, as well as proposed adjoining development to the north of the site.

Figure 3 Council HLEP 2001 zoning map

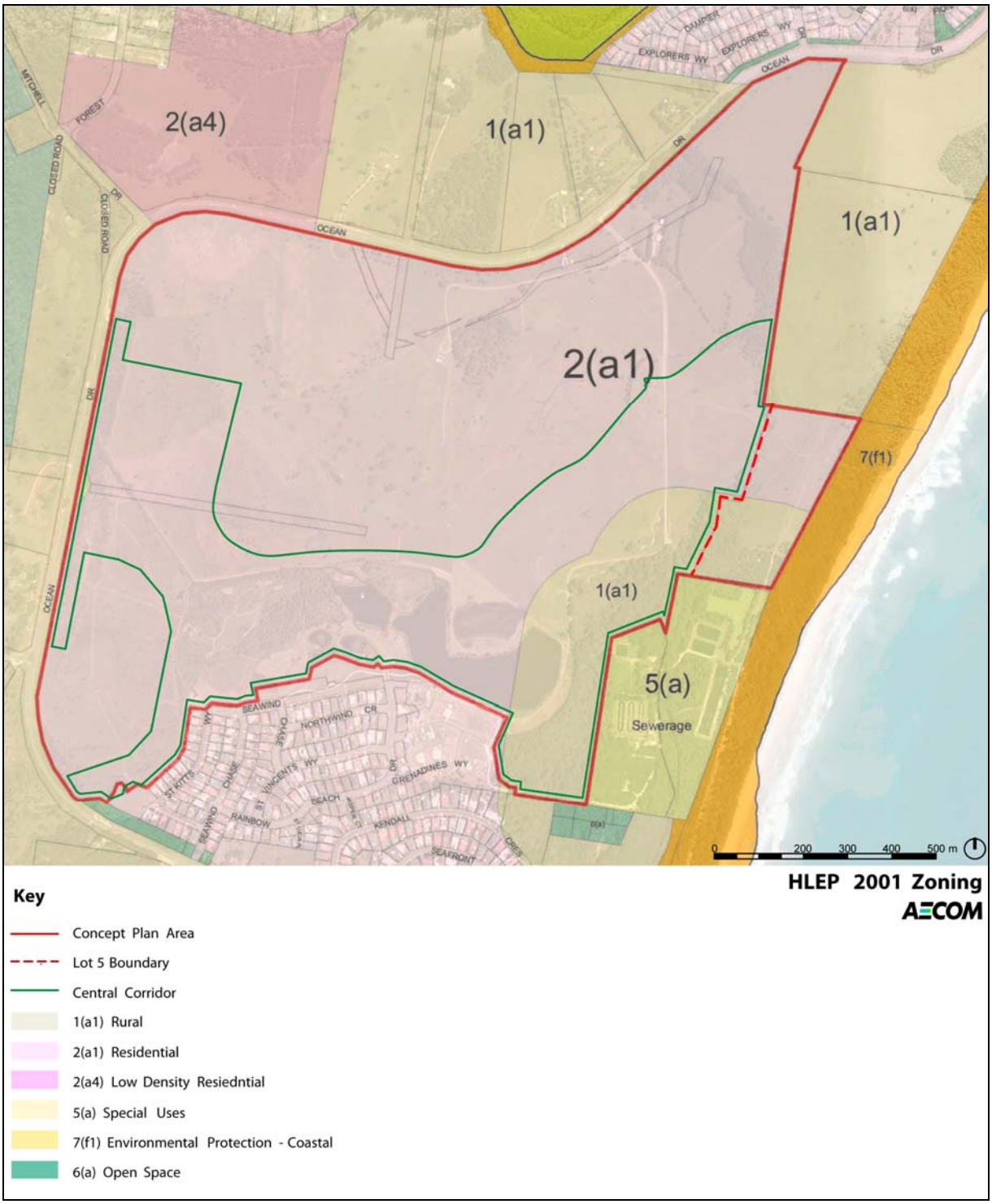


Figure 4 Council Area 14 structure Plan

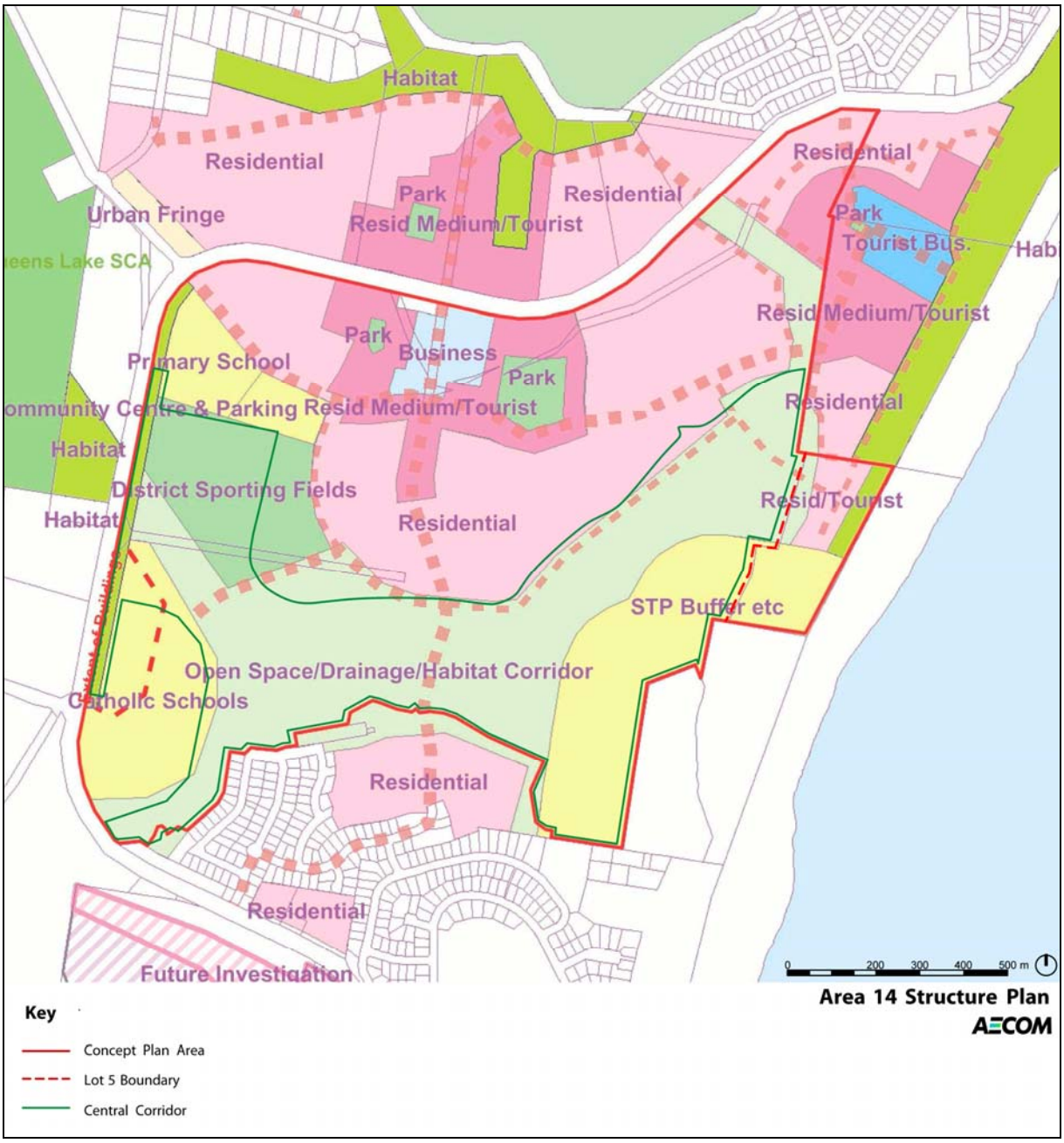
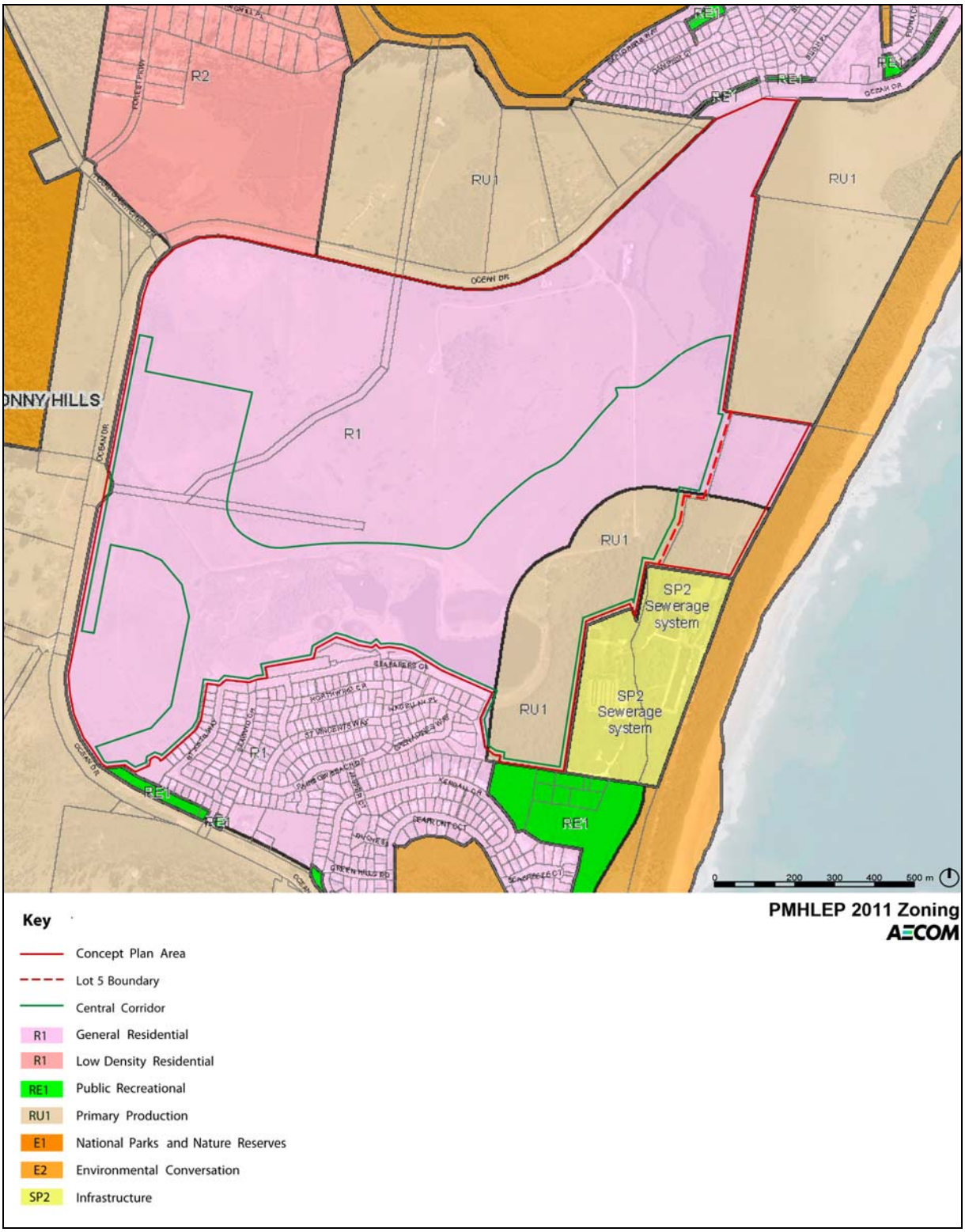


Figure 5 Council PMHLEP 2011 zoning map



2.2 Urban design principles plans

The nature and location of land uses proposed by the Concept Plan have been largely driven by and are consistent with Council's existing Greater Lake Cathie and Bonny Hills Urban Design Master Plan for Area 14 (UDMP). The UDMP provides an overall integrated land use and movement structure plan for Area 14 and details the core urban design principles that underpin the structure plan and seek to guide urban structure and built form.

Building upon Council's urban design principles for Area 14, a set of more detailed urban design principles is put forward below to create the framework and strategic intent for development of the site. These principles are sympathetic to site constraints and consistent with existing development and surrounding environments.

The urban design principles are made up of the following components, which are each discussed in further detail in sections below.

- Land use composition;
- Access and movement;
- Edge treatment; and
- Urban form.

2.2.1 Land use composition

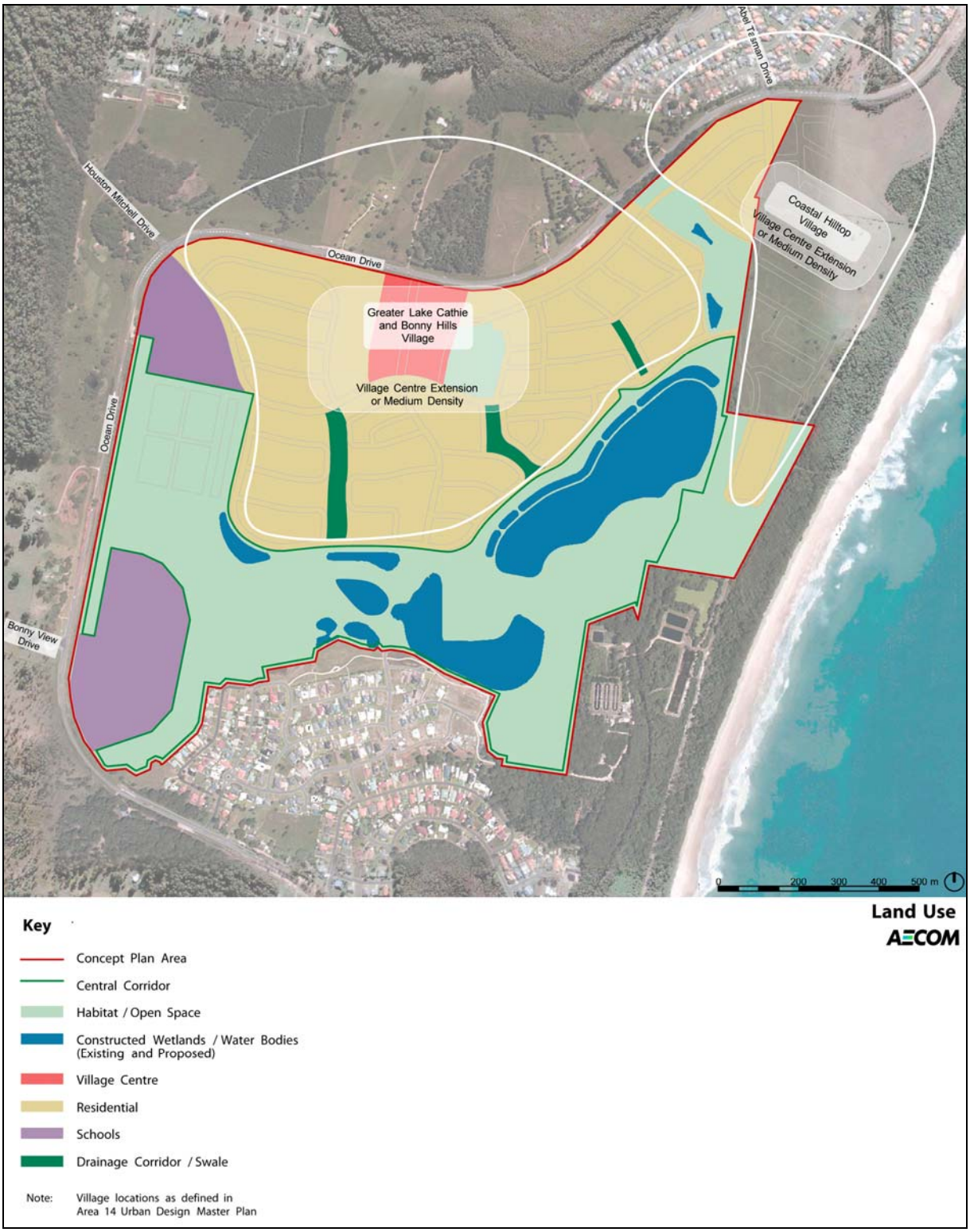
The design principles for land use composition illustrate how the urban components of the Concept Plan will be developed in the future. The land use composition of the proposal was largely defined by the following conditions:

- Maintaining consistency with Council's structure plan for Area 14 and UDMP core urban design principles, including the provision of neighbourhoods identified in the UDMP as follows:
  - The Greater Lake Cathie and Bonny Hills Village neighbourhood, and
  - The Coastal Hilltop Village neighbourhood.
- Winning of material from the proposed open water wetland to fill low lying areas currently unsuitable for residential development. Placement of fill is required to provide adequate land to meet Council's population targets and associated community and commercial land use elements such as playing fields and schools.

As illustrated in Figure 6, the above results in a land use composition that enables:

- Location of larger scale uses including schools and playing fields on the periphery to enable higher densities within a 400 m walkable catchment of village centres.
- Integration with existing residential development to the south and proposed urban development to the northeast, including the future Coastal Hilltop Village.
- Retention of existing habitat areas within the site and formalisation of protective buffer areas around the STP and littoral rainforest.
- Enhancement of bush regeneration areas within the Central Corridor.
- Design and location of active open space areas to create accessibility to future populations, while also providing separation from bush regeneration and habitat areas.
- Largely uninterrupted provision of drainage swales to facilitate the movement of stormwater through the site and integration of water sensitive urban design elements.

Figure 6 Land use composition



2.2.2 Access and movement

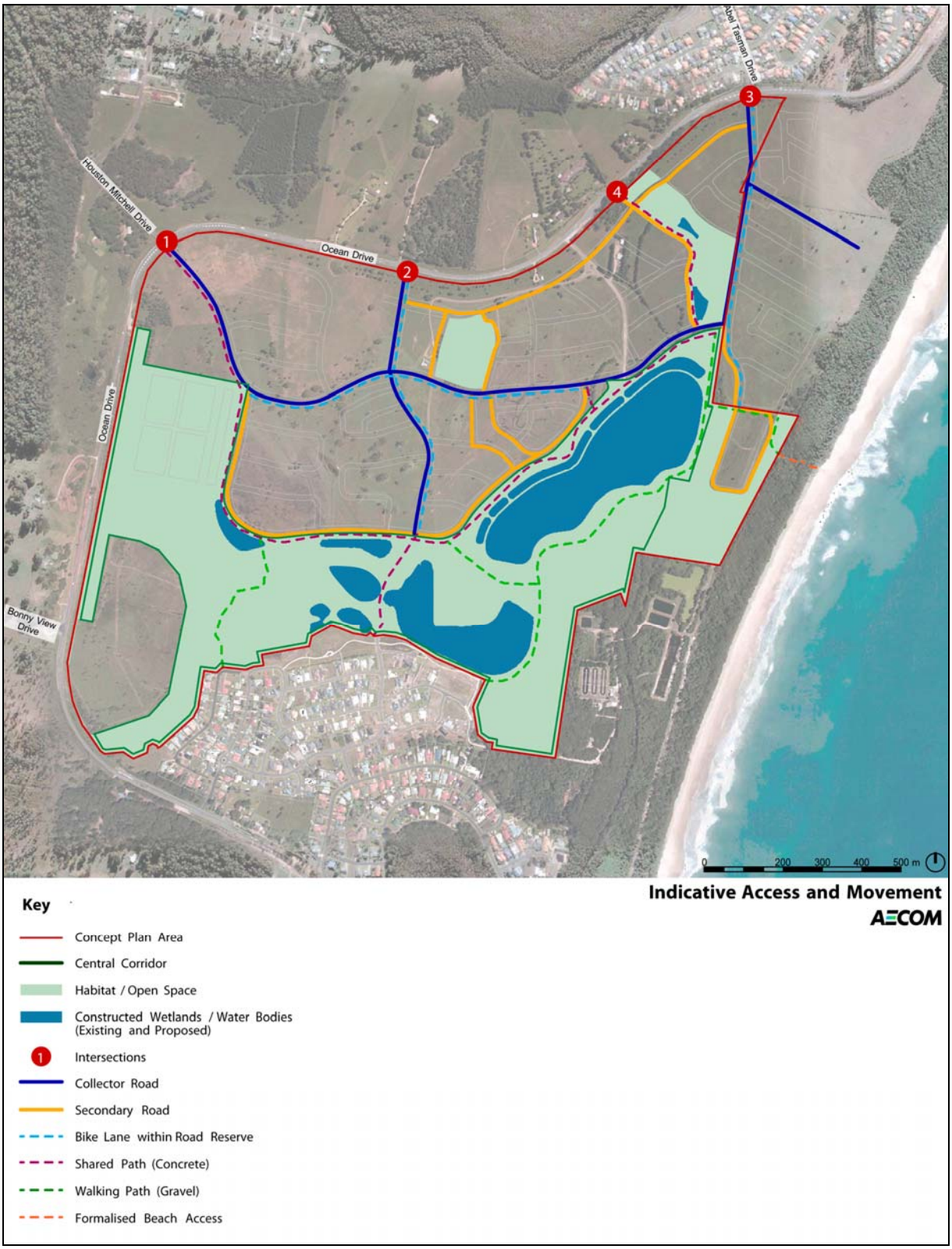
The design principles for access and movement within the site outline the proposed approach to provide good legibility, permeability and connectivity for vehicles, pedestrians and cyclists both within the site and beyond. The key elements of the access and movement hierarchy are:

- Four intersections providing vehicular access to Ocean Drive.
- Collector roads – proposed to provide direct access between the neighbourhood's village centres and designed to accommodate more than 3,000 vehicles per day.
- Secondary roads – streets are interconnected and are laid out to provide direct access and choice of routes to the two neighbourhood village centres.
- Perimeter streets – located at the interface of the residential precincts and the open space, drainage and habitat areas. Perimeter streets also provide separation areas for asset protection zones.
- Shared paths - pedestrian and cycle paths located along collector, secondary and perimeter streets. Shared paths also provided within the Central Corridor providing connections to the south and east.

As illustrated in Figure 7, the above results in an access and movement network that offers:

- An interconnected street network with strong links between the village centres and a network of collector roads providing efficient public transport routes.
- Good accessibility, route choice and detailing, making walking and cycling pleasant, efficient and safe.
- A pedestrian and cycleway network that is designed to provide safe, accessible linkages between the village centres, open space corridor and community facilities.
- Dwellings with frontage to perimeter streets have advantageous views, while also serving as passive surveillance points to the street and public spaces beyond.
- A flexible collector and secondary street network that can be detailed to provide a uniform, grid-like local road network.

Figure 7 Access and movement



2.2.3 Edge treatment

As illustrated in Figure 8, edge treatments are required to address the following site conditions:

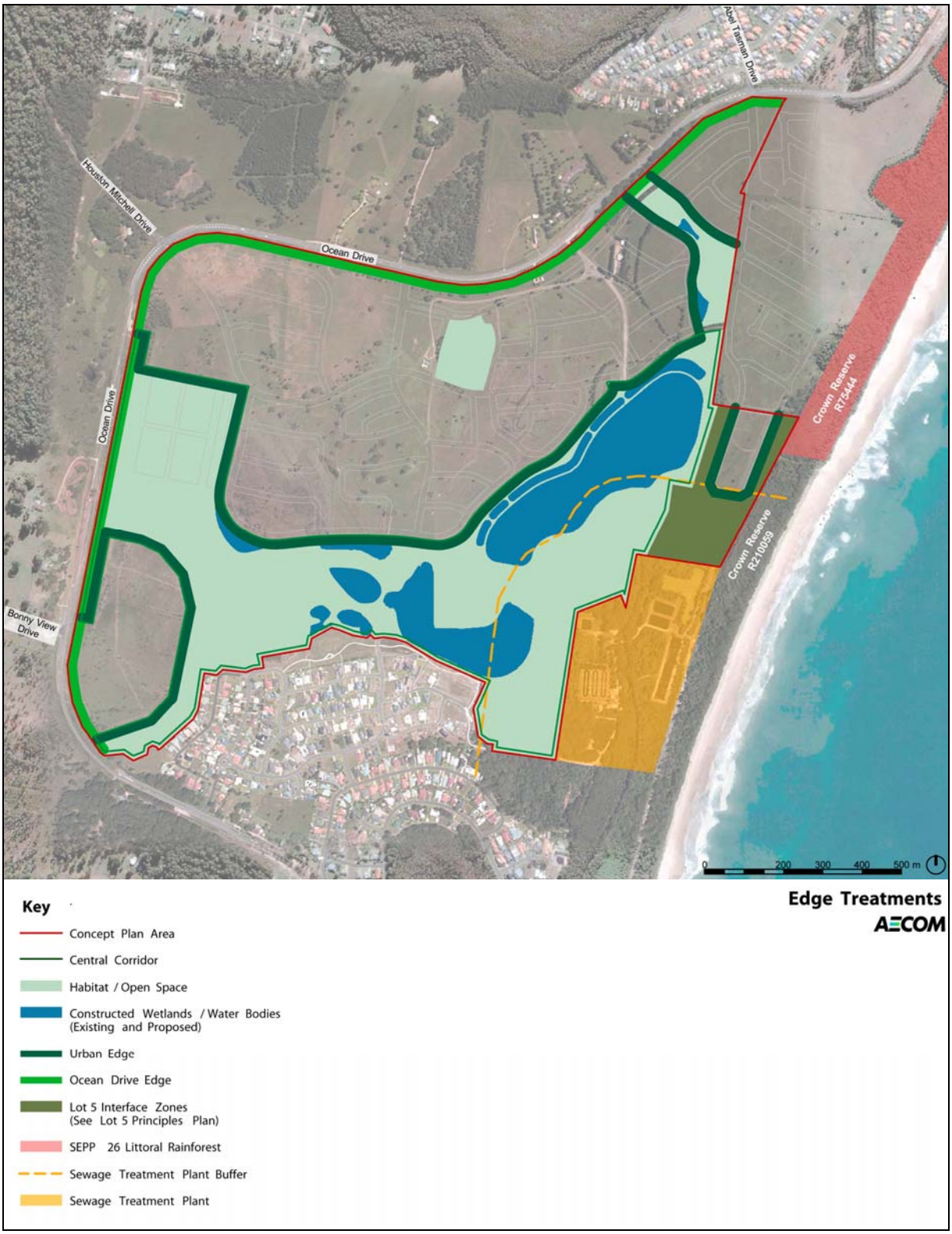
- Consideration of the interface between future built form on the site and Ocean Drive.
- Provision of appropriate urban edge treatments between future urban development and the habitat / open space corridors.
- Identification of Council's zoned STP setback.
- Interface areas between future development on Lot 5 DP 25886 and existing SEPP 26 littoral rainforest and coastal vegetation located on Crown land.

Council is preparing a draft DCP for Area 14. As part of this, Council plans to commission an Area 14 Ocean Drive corridor plan which will address key objectives along the length of the corridor, including noise attenuation, road safety, amenity, interface with future built form on the adjacent lands, sustainable transport modes and sustainable maintenance of landscaping in the public domain along the corridor edges. The proposal locates future residential, educational and village centre land uses adjacent to the Ocean Drive corridor. Detailed design of these urban areas will be undertaken in accordance with Council's objectives outlined within the Area 14 Ocean Drive corridor plan.

Provision of appropriate urban edge treatments between future urban development and the Central Corridor has been considered as part of the Project Application. An open space management strategy (OSMS) has been prepared that outlines key management issues for the urban edge including management of domestic pets and control mechanisms to prevent weed infestations from urban development. The OSMS will be implemented as part of the Project Application.

As detailed in Section 2.1, a principles plan for Lot 5 DP 25886 has been developed that includes interface areas to mitigate potential impacts from the development of Lot 5. The Lot 5 principles plan also identifies Council's STP setback, which will serve as a habitat link between existing coastal vegetation on Crown land and the Central Corridor.

Figure 8 Edge treatment



2.2.4 Urban form

Urban form principles include a residential density analysis and proposed dwelling yield plan which outlines indicative dwelling yields and densities for the proposal. Urban design guidelines have also been developed that provide guidance for the future character and built form for future residential development.

Indicative densities and dwelling yields

As illustrated in Figure 9, the proposal includes a range of residential densities as follows:

- Low density housing with a density of 15 dwellings/ha to be located adjacent to edge treatment areas including Ocean Drive and coastal vegetation (Lot 5). A variety of building typologies will be provided, comprising single dwellings, duplexes and integrated housing. Lot sizes will generally range from 450 – 550m^2.
- Medium density housing with a density of between 20 – 25 dwellings/ha concentrated around the proposed Greater Lake Cathie and Bonny Hills Village and Coastal Hilltop Village neighbourhoods. A variety of building typologies will be provided, including townhouses and two to three storey residential flat buildings.

Based on indicative residential densities and dwelling yields shown in Table 2.2 below an overall yield of 1015 dwellings may be achievable for the site based on an average of 16 dwellings/ha. This indicative dwelling yield is consistent with the 1109 dwellings estimated within Council's UDMP. However Table 2.2 demonstrates an indicative density and dwelling yield only. Actual density and dwelling yield can only be determined as part of detailed site analysis and design, which will be undertaken as part of a future project or development application(s) for the site.

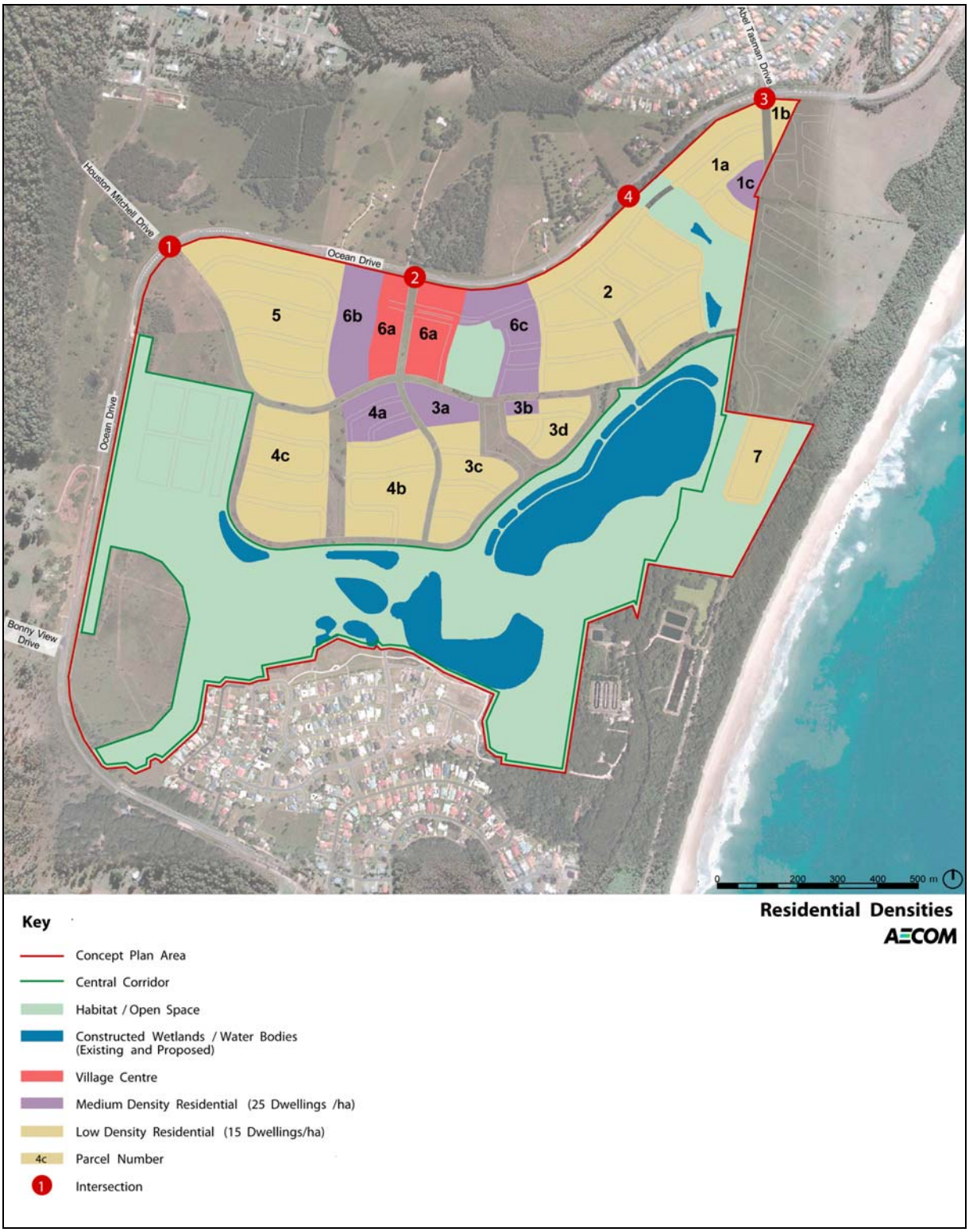
Table 2.2 Indicative residential densities and dwelling yield

Stage	Parcel Identifier	Area (ha)	Land Use	Dwellings per ha	No. of Dwellings	Total Dwellings
1	1a	4.45	Low Density	15	67	91
	1b	0.46	Low Density	15	7	
	1c	0.69	Medium Density	25	17	
2	2	14.00	Low Density	15	210	210
3	3a	1.32	Medium Density	25	33	131
	3b	0.30	Medium Density	25	8	
	3c	3.94	Low Density	15	59	
	3d	2.08	Low Density	15	31	
4	4a	1.96	Medium Density	25	49	232
	4b	5.39	Low Density	15	81	
	4c	6.79	Low Density	15	102	
5	5	10.53	Low Density	15	158	158
6	6a	4.30	Village Centre	N/A	N/A	159
	6b	3.01	Medium Density	25	75	
	6c	3.34	Medium Density	25	84	
7	7	2.39	Low Density	15	34	34
Total					**1015**	**1015**

NOTE: Areas shown for identified parcels include local roads but not collector streets, Ocean Drive setback, environmental corridors or regional parks.

NOTE: Identified parcels are based on indicative staging plan. Actual staging may not follow the indicative staging plan.

Figure 9 Indicative residential densities



Urban design guidelines

The following development objectives are put forward to demonstrate how the future character of development within residential precincts will be guided.

Site planning and orientation

- Dwellings should be orientated to maximise solar access to the main living areas and principle areas of open space.
- Consideration of the location of windows, balconies and outdoor entertaining areas is required to provide visual and acoustic privacy.
- Private outdoor open space areas should be useable and meet the occupants' requirements for privacy, safety, access and outdoor activities.

Built form

- Where appropriate, setbacks should be varied to preserve mature trees and enhance individual site features.
- Setbacks may incorporate a number of minor building elements such as a balcony, deck, bay window, shading elements, or entry features to the building.

Building design

- Elements such as varied roof forms, eaves, vertically oriented windows, verandahs and formal entries are encouraged to provide visual interest.
- Articulation to the front facade is encouraged to achieve an acceptable streetscape.
- Entrances should provide shelter and be visible from the street.
- Casual surveillance should be provided by windows from living areas overlooking street frontages.
- Garages should not dominate the streetscape.
- Car parking for medium density development should be located at the rear or under buildings.

Council is currently preparing a draft DCP for Area 14 which includes controls relating to building height, floor space ratio, setbacks and other key planning controls. Future development within the proposal will comply with Councils adopted DCP for Area 14.

2.3 Staging

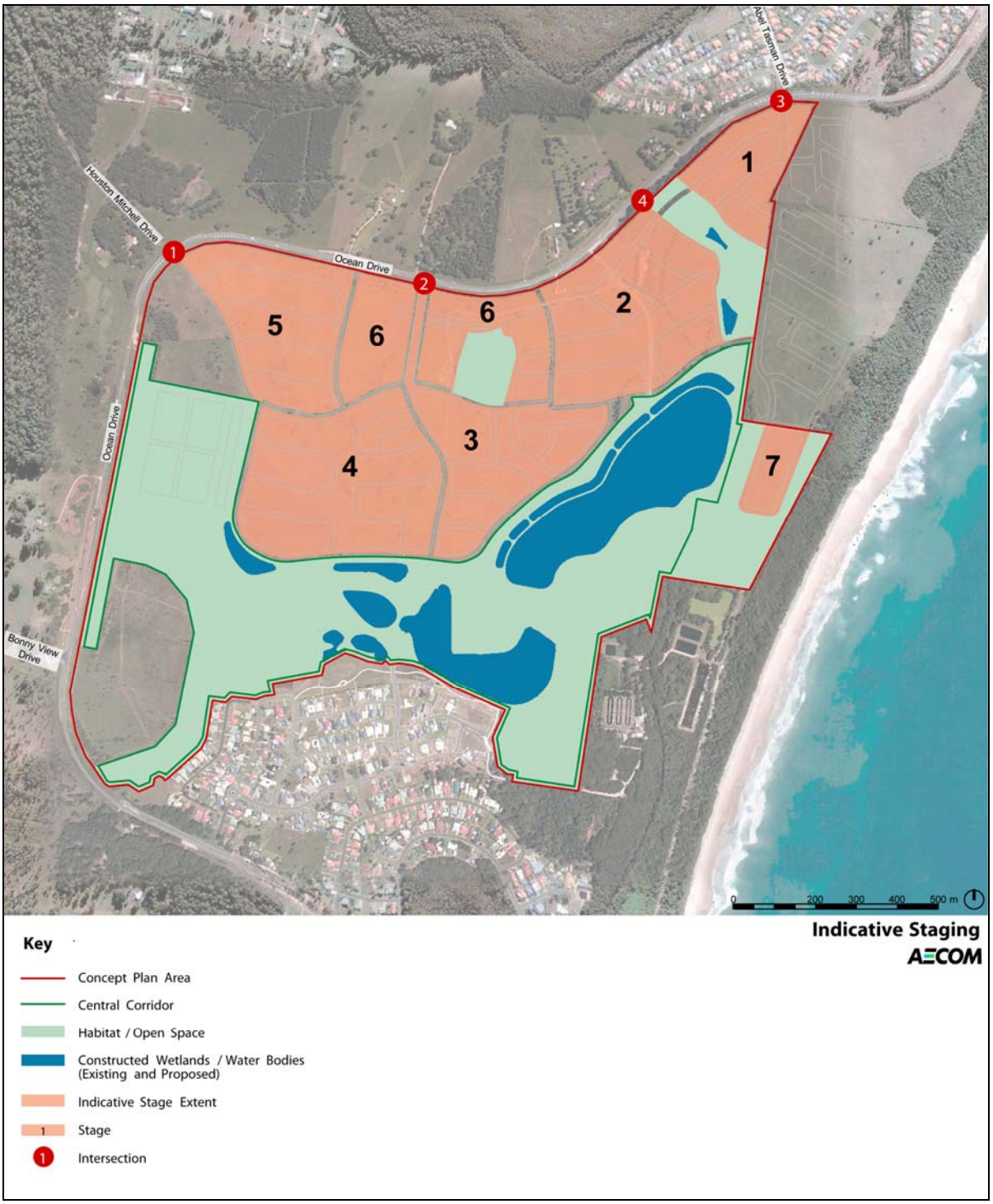
The indicative staging for the delivery of the Concept Plan is illustrated in Figure 10 and outlined in Table 2.2. The large scale of the site, with access available via any combination of the four intersections along Ocean Drive provides staging choices to respond to the orderly development the site and the adjacent and neighbouring properties.

The indicative staging plan also seeks to retain flexibility in the staging of the proposal at this Concept Plan stage. In this regard, staging for development of the Concept Plan is largely dependent on Council's sequencing of the four road intersections along Ocean Drive. Development of these intersections is in turn dependent on the development programs of the adjacent and neighbouring properties gaining access from the individual intersections. The staging is also dependent on the coordination of the optimum provision of service infrastructure to the site and the adjacent and neighbouring properties. Further, medium density development is dependent on the timing of provision of retail and community facilities within the Greater Lake Cathie and Bonny Hills Village Centre.

Table 2.3 Indicative staging

Stage	Land Use	Dwellings per ha	Timing
1	Low density Medium density	15 25	Timing dependent on construction of intersection with Abel Tasman Drive (intersection no. 3) and development program for adjacent Milland & Seawide property.
2	Low density	15	Intersection no. 4 enables flexibility in timing of Stage 2, as development can proceed independently of Stage 1. However development following Stage 1 would be preferred. Timing of intersection no. 4 is likely to be driven by landholders on the northern side of Ocean Drive.
3 & 4	Low density Medium density	15 25	Development of either or both of Stages 3 and 4 will require provision of intersection no. 2 and construction of a collector road through the village centre. Development of medium density residential provided within Stages 3 and 4 is dictated by provision of retail and community services in village centre.
5	Low density	15	Development dependent on provision of intersection with Houston Mitchell Drive (intersection no. 1).
6	Village centre retail and community facilities Medium density	N/A 25	Anticipated that intersection no. 2 will be completed as part of earlier stages. Development of the facilities in the village centre will respond to identified demand for retail and community services from within the Area 14 catchment. Major medium density residential precinct likely to proceed following availability of retail and community services in village centre.
7	Low density	15	Proposed east-west road at northern boundary of Lot 5 DP 25886 provides the only vehicular access to Stage 7. This will be provided as part of the adjacent Milland & Seawide development. Timing of Stage 7 is reliant on the development of the adjacent Milland & Seawide property and associated east-west access road.

Figure 10 Indicative staging



3.0 Revised statement of commitments

The environmental assessment for the Concept Plan identified a range of environmental outcomes and management measures that would be required to avoid or reduce the environmental impacts.

After consideration of the issues raised in submissions, the draft statement of commitments for the Concept Plan (refer to **Chapter 12** of the environmental assessment) has been revised. Should the proposal be approved, the revised commitments would guide the subsequent phases of the Concept Plan proposal.

In addition, the proponent is committed to integrating the constructed wetlands proposed for the Central Corridor within the overall stormwater treatment train and that the design of the urban area will result in overall compliance with Council's IWCM policy. This has been discussed and agreed with Storm Consulting as an appropriate methodology with respect to WSUD. A specific commitment in this regard is included within **Table 3.1**.

The revised statement of commitments, including commitments relating to the key issues described in the DGRs is provided in **Table 3.1**.

Table 3.1 Revised statement of commitments

Issue	Commitment	Timing
Detailed design	Detailed design of the various components of the Concept Plan will comply with the design and consultation provisions of relevant legislation, EPIs, Council codes, *Planning for Bushfire Protection* (RFS, 2006), BCA, Australian Standards (where relevant) and other requirements.	Subsequent development application stage, as appropriate.
	Detailed design of future buildings (for residential, educational, commercial, community and tourist uses) will comply with the provisions of relevant development controls, SEPP 65 (where relevant), *Planning for Bushfire Protection* (RFS, 2006), BCA, Australian Standards (where relevant) and BASIX.	Subsequent development application stage, as appropriate.
	The detailed design of the various components of the urban areas within the Concept Plan shall comply with Council's IWCM Policy for Area 14. Specifically, a WSUD treatment train will be implemented that comprises stormwater treatment measures in the urban areas plus constructed wetlands in the Central Corridor. Together, these will comply with the requirements of Council's IWCM Policy.	Subsequent development application stage, as appropriate.
Habitat protection and enhancement	A vegetation management plan is to be prepared for the site that outlines measures to protect and enhance habitat areas.	Subsequent development application stage, as appropriate.
Open space, recreation and habitat management	The proponent is to enter into a VPA with Council under Section 75F(6) of the EP&A Act in regards to the establishment and management and dedication of open space, recreation and habitat areas.	Subsequent development application stage, as appropriate.
Infrastructure provision	Provision of infrastructure and utilities will be in accordance with the requirements of Council, or other relevant service authorities.	Subsequent development application stage, as appropriate.
Section 94 contributions	Contribution towards the upgrading of the road network in accordance with Council's Major Roads Contributions Plan.	Contribution to be made prior to release of subdivision certificate or construction certificate for subsequent development applications, as appropriate.
	Contribution towards the provision of community facilities in accordance with Council's Community, Cultural & Emergency Service Facilities Contributions Plan.	Contribution to be made prior to release of subdivision certificate or construction certificate for subsequent development applications, as appropriate.
Transport and access	Detailed design of the various components of the Concept Plan will make provision for a bus service route to service urban areas and pedestrian / cycle connections throughout the site.	Subsequent development application stage, as appropriate.
	Pedestrian access to Rainbow Beach will be restricted to a formalised access way.	Subsequent development application stage, as appropriate.
Environmental mitigation and	Detailed management and monitoring plans will be prepared to address relevant environmental issues including stormwater, groundwater, surface water quality, soil erosion and sediment control, acid sulfate	Prior to issue of subdivision certificates or construction certificates for

Issue	Commitment	Timing
management measures and monitoring	soils, construction impacts, waste generation and collection, construction traffic and pedestrian management and noise and vibration.	subsequent development applications, as appropriate.
Integrated water cycle management	Development of the residential areas of the site will incorporate: • Water sensitive urban design (WSUD) incorporated into urban areas. • Use of reclaimed water to dwellings for outdoor use, toilet flushing and laundry cold water. • Irrigation of district sports fields with reclaimed water sourced from Council.	Subsequent development application stage, as appropriate.
Aboriginal heritage	Works are to comply with relevant DECCW Aboriginal cultural heritage guidelines and requirements of the *National Parks and Wildlife Act 1974.*	Subsequent development application stage, as appropriate.
Contamination	Compliance with SEPP No. 55 – Remediation of Land for areas of localised soil impact identified, or additional areas identified during future site works.	Subsequent development application stage, as appropriate.
Noise mitigation	Development will be protected from excessive traffic noise associated with Ocean Drive in accordance with Council's objectives outlined within the Area 14 Ocean Drive corridor plan.	Subsequent development application stage, as appropriate.
Consultation	Consultation with relevant stakeholders as part of future project or development applications for the proposal.	Subsequent development application stage, as appropriate.
	Consultation with Council regarding development of the Area 14 Ocean Drive corridor plan.	Subsequent development application stage, as appropriate.
Lot 5 DP 25886	Notwithstanding permissible uses within the R1 General Residential zone under PMHLEP 2011, Lot 5 will developed as low density residential only.	Subsequent development application stage, as appropriate.
	Lot 5 will be developed with a density of no more than 15 dwellings/ha.	Subsequent development application stage, as appropriate.
	Revegetation and interface planting within Zones 1, 2, 3 and 4 will be implemented and managed as per a vegetation management plan for the whole of Lot 5.	Subsequent development application stage, as appropriate.
	APZs will be implemented and managed as per a vegetation management plan for the whole of Lot 5.	Subsequent development application stage, as appropriate.
	The proponent is to enter into a VPA with Council under Section 75F(6) of the EP&A Act in regards to the management and dedication of future public land within Lot 5.	Subsequent development application stage, as appropriate.

4.0 Glossary of terms and abbreviations

Terminology	Description
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
Area 14 Structure Plan	Port Macquarie – Hastings Council adopted Lake Cathie & Bonny Hills Master Plan 2004 for the Area 14 Release Area
ASS	Acid Sulfate Soil
ASSMP	Acid Sulfate Soil Management Plan
BCA	Building Code of Australia
CEMP	Construction and Environmental Management Plan
Concept Plan	Major Project 06_0085
Council	Port Macquarie – Hastings Council
DCP	Development Control Plan
DDA	Designated Developable Area
DECCW	NSW Department of Environment and Climate Change and Water
DG	Director General
DGRs	Director General's Environmental Assessment Requirements
DoP	NSW Department of Planning
DP	Deposited Plan
E1	Existing Lagoon
EA	Environmental Assessment
ECC	Endangered Ecological Community
ELUMP	Environmental Land Use Management Plan
EP&A Act 1979	*Environmental Planning and Assessment Act 1979*
EPBC Act 1999	*Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
HLEP 2001	*Hastings Local Environmental Plan 2010*
IWCM	Integrated Water Cycle Management
KPOM	Koala Plan of Management
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
MP	Major Project under Part 3A of the EP&A Act
NoW	NSW Office of Water
OSMS	Open Space Management Strategy
Part 3A	Part 3A Major Project or Part 3A of EP&A Act
PASS	Potential Acid Sulfate Soil

PMHC	Port Macquarie – Hastings Council
PMHLEP 2011	*Port Macquaire – Hastings Local Environmental Plan 2011*
POEO Act 1997	*Protection of the Environment Operations Act 1997*
Project Application	Major Project 07_0001
Proponent	St Vincent's Foundation Pty Ltd
Proposal	Rainbow Beach Concept Plan (MP 06_0085) and Project Application (MP 07_0001)
RFS	NSW Rural Fire Service
RTA	Roads and Traffic Authority
SEPP	State Environmental Planning Policy
SSFCF	Swamp Sclerophyll Forest on Coastal Floodplains
STP	Sewerage Treatment Plant
Structure Plan	Area 14 Structure Plan
Subject Site	Part Lot 1232 DP 1142133, Lots 1, 2, 3 and 4 DP1150758 and Lot 5 DP 25886
SVF	St Vincent's Foundation Pty Ltd
VPA	Voluntary Planning Agreement
WSUD	Water Sensitive Urban Design
W1	Proposed Open Water Wetland

Appendix A

Ecology Lot 5 DDA assessment

Appendix A Ecology Lot 5 DDA assessment

DARKHEART
Eco-Consultancy

Thursday, 7 April 2011

Mr Brian Tierney
Tierney Property Services
PO Box 493
Port Macquarie
NSW 2444

Dear Brian,

RE: Rainbow Beach Concept Plan (06_0085) PPR – Lot 5 Delineated Development Area

Further to your request, I have reviewed the new Lot 5 Principles Plan delineating a proposed development area within Lot 5 DP 25886, and provide the following comments.

1.0 BACKGROUND INFORMATION

1.1 Original Ecological Assessment:

In my ecological assessment (Darkheart 2009) of the original applications for the St. Vincent's Foundation Property, the Executive Summary included the following statements which are of key relevance to the proposed development area:

> "The major ameliorative measure proposed by the proponent is the Open Space/Drainage/Habitat Corridor which was a measure designated in the UIA 14 Structure Plan. The Open Space Management Strategy (OSMS), which forms part of both Applications, details the specific measures (eg via a Vegetation Management Plan) that will be undertaken to formally establish and improve the ecological functioning of this area (which will encompass some 53.82ha), with the aim to:
>
> - enrich the current native biodiversity of existing vegetation within the Open Space Corridor;
> - enhance the existing corridor values of vegetation along Duchess Gully;
> - create better movement opportunities in an east-west direction for native wildlife;
> - reduce the extent of existing weed infestations within the Open Space Corridor;
> - protect and enhance aquatic habitat values within existing and to be constructed waterbodies within the Open Space Corridor; and

39 Lake Ridge Drive Via Laurieton NSW 2443
Phone: (02) 65 59 00 75 ♦ Fax (02) 65 59 00 75 ♦ Mobile: 0409 833 968
E-Mail: darkhearteco@gmail.com
Member: NSW Ecological Consultants Association
NSW Royal Zoological Society, Australian Plant Conservation Network
Australasian Bat Society, Australian Herpetological Society, Restoring Biodiversity Industry Association

- provide an appropriate interface between native vegetation and wildlife habitats within the Open Space Corridor and adjacent areas of urban development.

- Restore some 15.1ha of Coastal Floodplain EECs an offset to loss of 0.8ha of these EECs."

And, under *Secondary Recommendations*:

> *"(iv) Proposed Southern School Site:* The southern half of the generally native grassland falling within the proposed eco-tourism site was found to support the Eastern Chestnut Mouse in 2003, but subsequent routine agricultural practices (including slashing) since this time places doubt on whether this species has remained viable in this area and/or in adjacent vegetation.
>
> The development footprint of the Eco-Tourism site is not known at this stage. However, the buffer to the STP ensures that the residential component of the development is restricted to the northern half of Lot 5, subject to setbacks for APZs from Duchess Gully and the dune vegetation to the east.
>
> Any future applications for development of the Eco-Tourism Site must ensure either the population is extinct (in which case ecological constraints are limited), or is not placed at risk of extinction. In the latter, development and management must ensure:
>
> - Sufficient habitat is retained to support a viable population.
> - No barriers to movement/dispersal are emplaced.
> - Fire/slashing is managed as required per the species ecology."

In addition the Conclusion to the original assessment was:

> "Overall, the PA proposal will have relatively minimal negative impacts on the current capacity of the property to support the recorded and potentially occurring threatened species and the viable EECs. The net effect of the proposal is considered likely to be an overall increase in biodiversity in the long term with a benefit to the biodiversity values of the locality as opposed to a net loss which is typically associated with urban developments, provided the appropriate ameliorative measures are implemented."

2.0 ASSESSMENT OF LOT 5 DELINEATED DEVELOPMENT AREA (DDA):

The proposed revised Concept Plan now shows a delineated development footprint (annotated as the Delineated Development Area) on Lot 5. This plan thus provides a clearer outline of the desired combination of ecological and development outcomes for this area.

An undefined area on Lot 5 was previously nominated for an Eco-Tourism development. The revised concept is now for a low density residential development over a specifically designated area of 2.24ha, in the middle north of the cleared pasture which dominates Lot 5. This envelope forms an extension of approved future residential development from adjoining land to the north. Access to this area will be provided by an extension of approved roads from the north, rather than across Duchess Gully, which prevents fragmentation of the riparian zone of Duchess Gully. The latter is considered ecologically preferred as this maintains the corridor values of the adjacent section of Duchess Gully, and minimises the threat of automobile collision with wildlife.

It is also noted that the DDA is significantly smaller than the area nominated in the Area 14 Urban Design Structural Plan. A total of 5.2ha (about 70%) is now proposed to be retained outside the DDA, and the Plan shows it has been mapped into management zones as follows:

- Zone 1 (2.25ha) contains the immature regrowth coastal sands forest which generally falls within the buffer to the Bonny Hills sewage treatment plan (STP).

- Zone 4 (about 0.8ha) encloses the existing riparian zone of Duchess Gully adjacent to the DDA.

- Zones 2 (1.35ha) and 3 (0.8ha) comprises the remainder of the pasture where the Eastern Chestnut Mouse was recorded in 2003, prior to re-commencement of regular maintenance of this area as part of routine farm practises.

It is understood that the remaining 5.2ha of Lot 5 is to be rehabilitated/revegetated (subject to bushfire provisions in proximity to the residential area). The primary objective of this work (to be undertaken at the proponent's expensive, and complimenting current extensive work in the adjacent Crown land and the remainder of the Habitat Corridor) is to significantly enhance the overall functional effectiveness of the east-west and north-south corridor encapsulated in the Open Space/Drainage/Habitat Corridor. This corridor, extending from Ocean Drive in the southwest, and expanding the remnant strip of dune vegetation along the coast between Lake Cathie and Bonny Hills, will reach a width of 175m across Lot 5 as a result. This width meets recognised corridor widths for effective wildlife corridors (Lindenmayer and Fisher 2006, CHCC 2009, Scotts 2002, Lindenmayer 1998), and ties in with the DECCW's modelled corridors (Scotts 2002). The corridor widening on Lot 5 also overall addresses the DECCW (2010) priorities of enhancing connectivity between coastal lowlands and hinterlands to address evolutionary trends and pressures induced and exacerbated by Climate Change.

Widening of the buffer zone to the littoral rainforest adjacent to Zone 3 to match a similar proposed buffer on adjoining land to the north is also in line with the principles of SEPP 26 and rainforest restoration (Peel 2010). Furthermore, appropriate planning of vegetation restoration on the eastern side of Zone 2 could have similar benefits for the long term regeneration of rainforest in formerly sandmined Crown land to the east of this area.

With respect to the Eastern Chestnut Mouse, which was identified as the key ecological constraint for Lot 5 in our report, the DDA partially falls over land where this species was recorded in 2003. Zone 2 and 3 constitute the remainder of the previously known habitat, and together are not considered sufficient in extent to support a viable population, should one still persist in this area.

As stated in our earlier assessment, if the Eastern Chestnut Mouse is now demonstrably extinct from Lot 5, then this species will obviously no longer be a key constraint on development on Lot 5. Based on observations over periodic site visits since 2003, persistence of the previously recorded small population appears most unlikely given the pasture is grazed by cattle and periodically slashed; recent habitat loss/modification of swamp forest on adjacent land to the south associated with expansion of the Bonny Hills Sewage Treatment Plant has further reduce the extent of potential habitat available to support a genetically viable population; and the lack of preferred or sufficient habitat types to the east in the Crown land, or in the regrowth sands forest in Zone 1 which could potentially act as viable refugia/source habitats post-slashing of the pasture.

Regardless, as per my original recommendation thus, any future development of Lot 5 must, at that particular time, ensure either the population is extinct (in which case ecological constraints would be low), or is not placed at risk of extinction as a result of the proposed development.

Overall thus, I consider that the proposed dedication and rehabilitation/revegetation of about 70% of Lot 5 will have a net positive ecological outcome for this portion of the site, corridor values, and the overall Concept Plan.

Yours faithfully,

Jason Berrigan.
Senior Ecologist, D.E.C.
B. Nat. Res. (Hons).Grad. Cert. (Fish.).
MECANSW, MRZSNSW, MABS, MAHS, MAPCN, MRBIA.

References:

Coffs Harbour City Council NSW (2009). *Coffs Harbour Priority Habitats and Corridors Strategy 2010 – 2030*, Consultation draft, Coffs Harbour, NSW.

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Lindenmayer, D. and Fisher, J. (2006). **Habitat fragmentation and Landscape Change: An ecological and conservation synthesis**. CSIRO Publishing, Collingwood.

Lindenmayer, D.B. (1998). **The Design of Wildlife Corridors in Wood Production Forests** – Forest Issues 4. NSW NPWS, Hurstville.

Peel, B. (2010). **Rainforest Restoration Manual for South-Eastern Australia**. CSIRO Publishing, Collingwood.

Scotts, D. (2002). **Key Habitats and Corridors for Forest Fauna of North-East NSW: A regional landscape to focus conservation, planning, assessment and management**. NSW NPWS, Hurstville.

Appendix B

Stormwater Lot 5 assessment

Appendix B Stormwater Lot 5 assessment

AECOM
Level 8, 17 York Street
Sydney NSW 2000
www.aecom.com

+61 2 8023 9333 tel
+61 2 8023 9399 fax

20 April 2011

James Dunn
Tierney Property Services
PO Box 493
Port Macquarie NSW 2444

Dear James,

Lot 5 Stormwater Treatment Requirements

Report Objective
The objective of this report is to determine the stormwater treatment requirements for the proposed development at Lot 5 (refer to Figure 1).

The Proposed Development
The proposed development at Lot 5 has the following characteristics that relate to stormwater quality treatment:

- 2.39 ha of delineated development area
- Approximately 34 low density residential lots (total 1.58 ha).Assumed 50% impervious fraction for lots (to be consistent with modelling for other areas of the Rainbow Beach development).
- Perimeter access road (0.81 ha). Assumed 90% impervious fraction for roads.

Stormwater Treatment Criteria
Stormwater treatment must be sufficient to meet the Port Macquarie Hastings Council adopted criteria in accordance with Council's IWCM policy of September 2006 as amended in November 2007. These criteria stipulate that the following load reductions must be achieved from the stormwater treatment train (comparison of unmitigated developed case verses developed mitigated case):

- 80% Reduction in Coarse Sediment (particles <= 0.5 mm) (TSS)
- 45% Reduction in Total Nitrogen (TN)
- 45% Reduction in Total Phosphorus (TP)

Stormwater treatment for lot 5 must also be consistent with the approaches and recommendations made by other consultants regarding water management on this development, namely:

- Cardno (Water Engineering and Environment DGR Assessments, Rainbow Beach Estate, Bonny Hills (April 2010)
- The Water Research Laboratory (WRL, University of NSW, Groundwater Characterisation and Numerical Modelling for Rainbow Beach Estate. March 2010), and
- AECOM (Rainbow Beach Stormwater Treatment and Wetland Functionality Report, July 2010).

Additionally, the LPMA "condition" (LMPA letter 22/10/10) was accommodated in this stormwater treatment design, namely:

> *"Stormwater runoff (including possible runoff from hard surfaced roads and car parks) must not be directed onto the adjacent Crown reserve."*

Stormwater Treatment Options
Stormwater from this site could be treated by either:

1. A single constructed stormwater treatment wetland
2. Bioretention systems distributed around the development or consolidated near Duchess Gully.

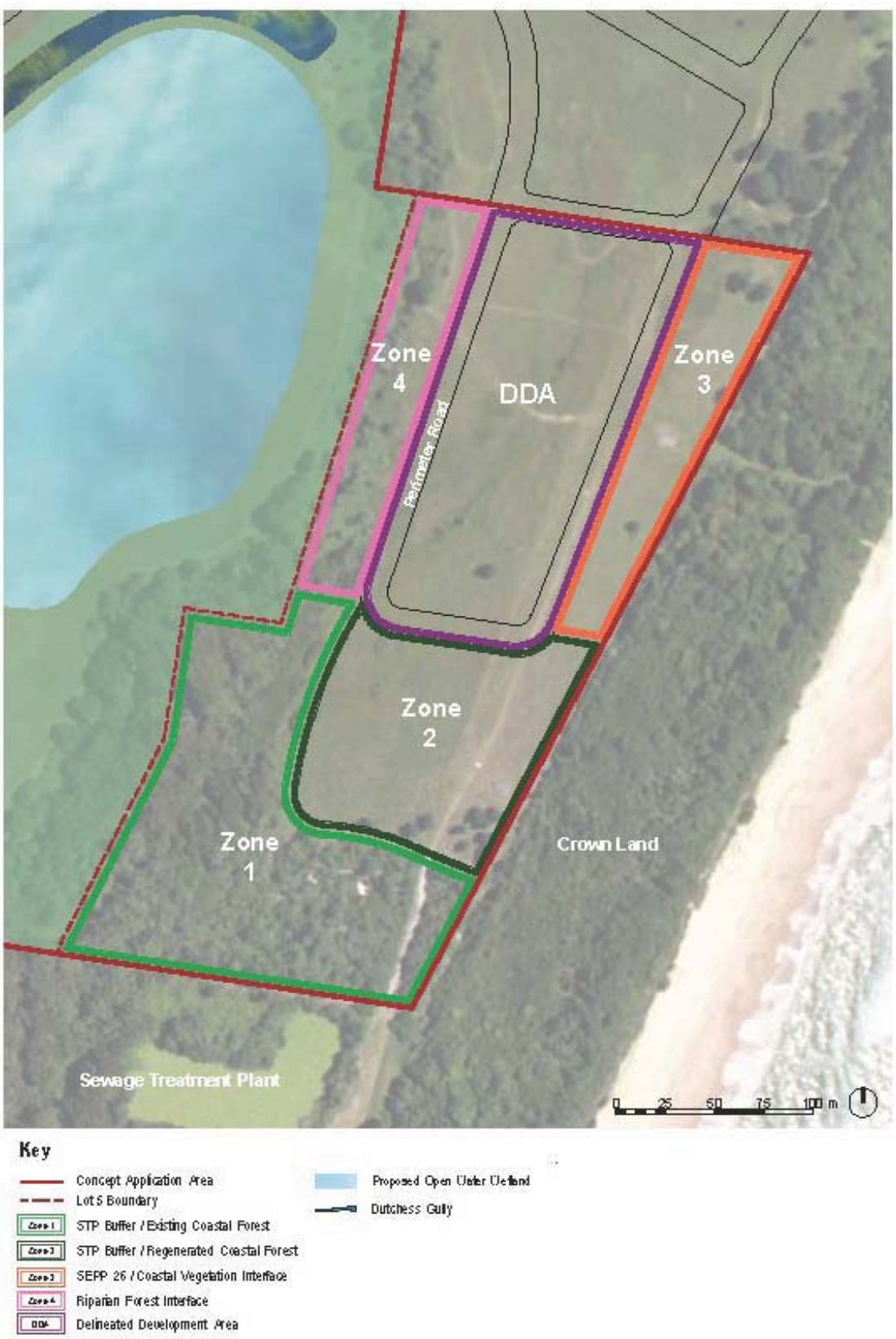


Figure 1. – Plan view of Lot 5 showing development location (DDA) and Duchess Gully. Duchess Gully lies to the immediate west of Lot 5, and flows southward at this location.

1. Stormwater Treatment with a Constructed Wetland

Stormwater runoff generated on Lot 5 will be discharged to Duchess Gully. Lot 5 sits on dune sands and will be constructed as flat terrain. Therefore, to accommodate the likely small level difference between the surface level and the discharge to Duchess Gully a constructed wetland is proposed for stormwater treatment. End-of-pipe constructed wetlands for stormwater treatment can work successfully in flat areas as very little grade difference is required to convey water through the wetland, whereas end-of-pipe bioretention systems require sloping sites in order to discharge treated water below surface level.

Constructed wetlands require protection from sediment, and therefore should be preceded by devices designed to remove sediment from stormwater, such as grassy swales or a sediment basin.

Wetland Design

The wetland design features and modelling parameters to be used as the basis of the constructed wetland design are described in detail in the AECOM “Stormwater Treatment and Wetland Functionality Report” (2010).

The following design parameters were applied to the constructed wetland treatment nodes of the MUSIC modelling:

Parameter	Details
Inlet pond volume (m^3)	Set at approximately 10% of the area of the macrophyte zone. Required to trap sediment and dissipate flow energy.
Macrophyte zone surface area (m^2)	Set at the area required to meet the pollutant reduction targets set by Council. Wetland extent was mostly driven by area required to meet TN removal of 45%.
Extended detention (m)	Set at 0.5m. Deeper than this puts the health of the aquatic vegetation at risk by potential drowning during extended wet periods.
Average Depth (m)	Set at 0.3m. Deeper than this puts the health of the aquatic vegetation at risk by potential drowning during extended wet periods.
Permanent pool volume (m^3)	Calculated based on average depth.
Equivalent outlet pipe diameter (mm)	Set to control the notional detention time at 72 hours. Detention times shorter than this are unlikely to provide adequate pollutant removal in practice. Detention times longer than this require a larger footprint to treat the same proportion of runoff.

Parameters used in MUSIC modelling

- Default pollutant generation parameters
- Rainfall record - The meteorological template used was 6 minute time step data from the Port Macquarie region for the years 1966 to 1970 inclusive. Monthly evapotranspiration data from the region was also used. Simulations over this period produced an annual rainfall of 1125 mm and annual potential evapotranspiration of 1318mm. This is the most complete local dataset available.
- Exfiltration rate of 0mm/hr reflecting a lined wetland.

MUSIC Modelling Results

Wetland properties required to achieve compliance with treatment criteria include:

- Inlet pond /sediment basin volume of 160m3
- Wetland surface area of 1600m^2 (80% of the surface area should be vegetated)
- Outlet arrangement to include 43mm diameter outlet pipe to achieve nominal 72 hour detention time.

Table 1 Wetland Treatment Effectiveness*

Pollutant	Sources (kg/y)	Residual Load (kg/y)	% Reduction
Total Suspended Solids	3600	688	80.9
Total Phosphorus	7.35	2.17	70.5
Total Nitrogen	52.7	25.6	51.5

*Results from MUSIC model 110412_Lot 5

Table **1** demonstrates that a constructed wetland with the above-mentioned properties will meet the requirements of Councils IWCM Policy for load reductions of TSS, TP and TN.

Location of Constructed Wetland for Stormwater Treatment

An appropriate location for the constructed stormwater treatment wetland is in Zone 2 (refer Figure 2). Zone 2 is large enough to contain the required stormwater treatment wetland drainage can be easily connected to an existing drainage line to Duchess Gully. Additionally, a wetland in this location provides a distinctive landscape asset for the residents while providing road access for easy maintenance access. Zone 2 is designated for bush regeneration works in the future, and the constructed wetland in this location is compatible with the use of this land for habitat provision, and as a buffer to the sewage treatment plant.

It was not considered practical to locate the constructed wetland in Zone 4. Zone 4 is a narrow corridor, alongside which Duchess Gully runs. Duchess Gully is drawn on 1:25 000 NSW topographic maps (Grants Head) as a 1st order stream, therefore it is likely to be a Category 3 stream under the Water Resources Act administered by the NSW Office of Water. Such a waterway requires a 10m riparian buffer either side of the top of bank and it was considered that sufficient space was not readily available alongside the stream. This categorization should be confirmed with the NSW Office of Water in order to determine what conditions the NSW Office of Water may place on the development.

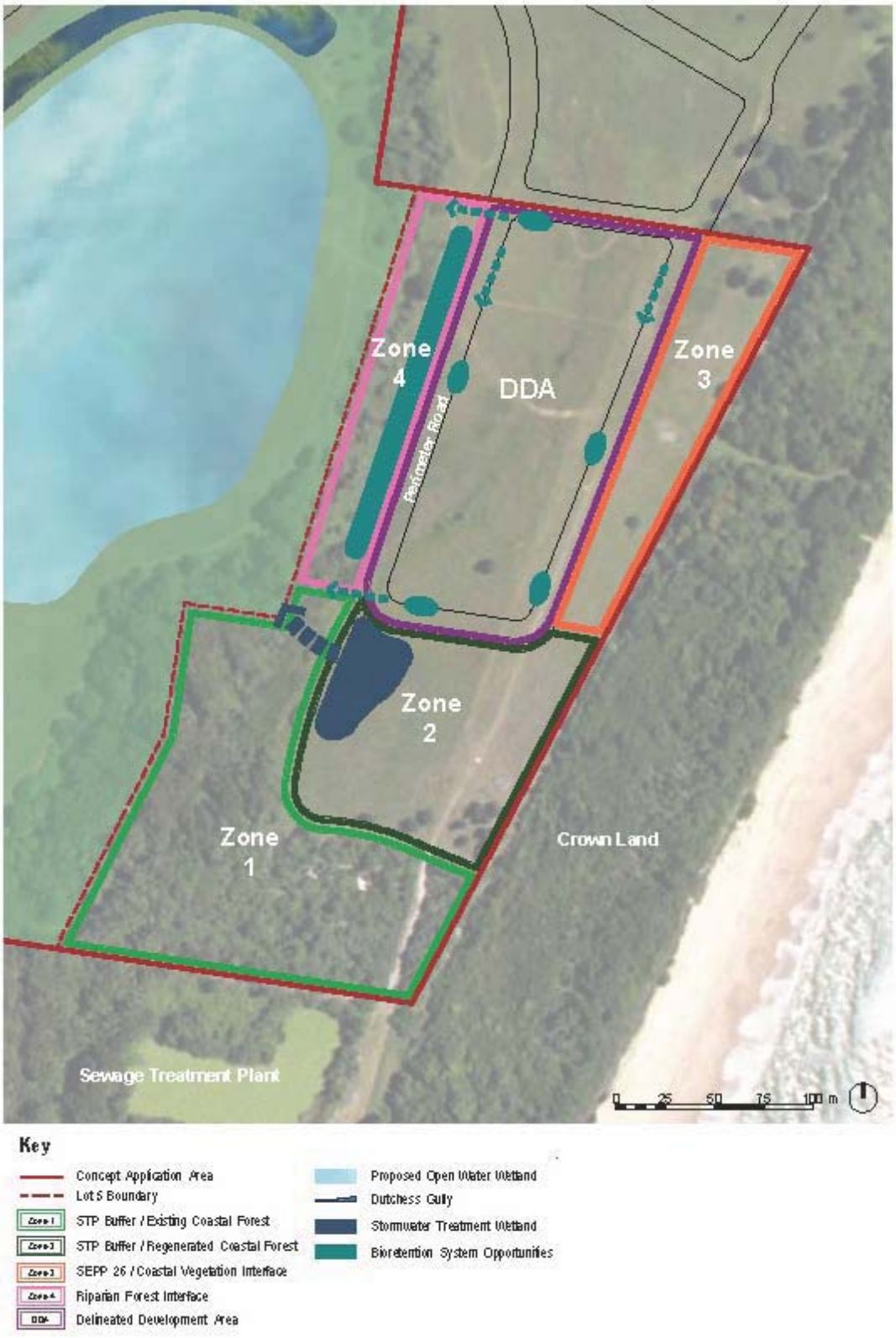


Figure 2. – Plan view of Lot 5 showing a potentially appropriate location for stormwater treatment devices. A constructed wetland approximately 1760 m^2 in size could be located in Zone 2. The wetland could discharge via a swale connection in an existing drainage line to Duchess Gully. Bioretention systems could be located alongside Duchess Gully, distributed around the development or in Zone 2.

Conveyance of Stormwater to Proposed Wetland

The proposal is that the development site is to be graded to drain stormwater to the south west corner of the site in a conventional piped minor drainage system. The wetland can operate with low extended detention (e.g. 0.2 to 0.3 m) to enable enough vertical fall for the system to drain. Swales can be used to drain the treated flows from the wetland, and any wetland high-flow bypass to Duchess Gully.

Figure 3. A swale at Rainbow Beach designed as a naturalized water course. This swale delivers urban runoff to the receiving water bodies while also providing water quality benefits, and is a plant community complementary to the adjacent native ecosystem.

2. Stormwater Treatment with Distributed Bioretention Systems

Bioretention systems distributed around the catchment can provide an alternative to constructed wetland systems. For this option to be viable, runoff must be directed to the bioretention system prior to reaching the stormwater drainage network. Filtered stormwater can then be directed from the bioretention system directly into the stormwater pipe network. Any overflow from the bioretention systems can bypass into nearby and typical side entry pits (examples of such bioretention systems shown in Figure 4).

Bioretention System Design

The bioretention system design features and modelling parameters to be used are described in detail in the AECOM "Stormwater Treatment and Wetland Functionality Report" (2010).

The following design parameters were applied to the bioretention system treatment nodes of the MUSIC modelling for Lot 5:

Parameter	Details
Extended detention (m)	Set at 0.2 m. Shallow extended detention would be required in systems incorporated into the streetscape.
Inlet sediment control zone (m^2)	Set at approximately 25% of the filter media surface area. Required to trap sediment and dissipate flow energy.
Exfiltration Rate (mm/h)	Set at zero. This is conservative and assumes that the bioretention system will be lined. The bioretention systems may not need to be lined, and if so, underdrainage may not be required
Filter Area (m^2)	Set at the area required to meet the pollutant reduction targets set by Council. Surface area extent was mostly driven by area required to meet TN removal of 45%.
Filter depth(m)	Set at 0.6 m. Does not include depth of transition and drainage layers (additional 0.3 m, 0.9 m total)
Filter median particle diameter (mm)	0.5
Sat hydraulic conductivity (mm/h)	100
Overflow weir width (m)	10

Parameters used in MUSIC modelling

- Default pollutant generation parameters
- Rainfall record - The meteorological template used was 6 minute time step data from the Port Macquarie region for the years 1966 to 1970 inclusive. Monthly evapotranspiration data from the region was also used. Simulations over this period produced an annual rainfall of 1125 mm and annual potential evapotranspiration of 1318mm. This is the most complete local dataset available.
- Exfiltration rate of 0mm/hr reflecting lined bioretention systems.

MUSIC Modelling Results

Bioretention properties required to achieve compliance with treatment criteria include:

- Inlet zone for sediment trapping area of 150 m^2
- Bioretention systems combined total surface area of 600 m^2

Table 2 Bioretention System Treatment Effectiveness*

Pollutant	Sources (kg/y)	Residual Load (kg/y)	% Reduction
Total Suspended Solids	3610	278	92.3
Total Phosphorus	7.27	1.63	77.5
Total Nitrogen	52.7	28.8	45.4

*Results from MUSIC model 110412_Lot 5

Table 2 demonstrates that bioretention systems with a combined footprint of 750 m^2 with the above-mentioned properties will meet the requirements of Councils IWCM Policy for load reductions of TSS, TP and TN.

Location of Bioretention Systems

Bioretention systems could be located in the following areas:

- Distributed around the development as landscape elements within the streetscape to provide traffic calming, visual buffering and shade.
- Alongside the Duchess Gully riparian corridor in Zone 4 (refer Figure 2).
- Some bioretention systems could provide a transition between the urban area and the bush regeneration to take place in Zone 2.

Figure 4. Bioretention Systems within the streetscape on a sandy, flat site at Bellvista Estate, Caloundra, Sunshine Coast, Queensland. (Design by AECOM).

Additional considerations for bioretention systems – Water Balance

Infiltration of stormwater treated by bioretention systems is possible. However, there are Endangered Ecological Communities of vegetation that occur on site and that could be affected by changes to the water table. Therefore, prior to infiltrating stormwater to groundwater, a water balance should be conducted to ensure that excess water generated by the urban development does not raise the water table. Usually, a consumptive use of water is required to reduce the delivery of water to the water table. This can be achieved by capturing most roof runoff in rainwater tanks and using this water for toilet flushing and/or hot water and garden irrigation.

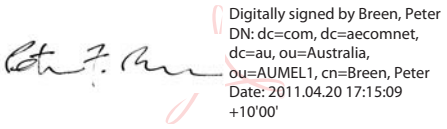
Conclusion

The concept design of stormwater treatment devices and modelling undertaken for Lot 5 has determined the requirements that must be made for the development to attain the stormwater treatment criteria adopted by Port Macquarie-Hastings Council.

Yours sincerely

AECOM Australia Pty Limited

Courtney Henderson
Senior Ecologist
Design + Planning



Peter Breen
Director
Design + Planning